

WHAT IS CLAIMED IS:

1. A phase changeable memory cell, comprising:
a substrate;
a bottom electrode on the substrate;
5 a phase changeable material layer pattern on the bottom electrode; and
a top electrode on the phase changeable material layer pattern, the top
electrode having a tip that extends toward the bottom electrode.
2. The phase changeable memory cell of claim 1, wherein the bottom
10 electrode has a planar portion and a vertical portion, and wherein the tip of the top
electrode extends toward the vertical portion of the bottom electrode.
3. The phase changeable memory cell of claim 2, wherein the bottom
electrode is cylindrical, and the vertical portion of the bottom electrode extends from
15 an edge of the planar portion of the bottom electrode.
4. The phase changeable memory cell of claim 1, wherein the phase
changeable material layer pattern is directly on the bottom electrode.
- 20 5. The phase changeable memory cell of claim 1, further comprising:
a lower interlayer insulating layer between the bottom electrode and the
substrate; and
a contact plug extending through the lower interlayer insulating layer and
electrically connecting the substrate with the bottom electrode.
- 25 6. A phase changeable memory cell, comprising:
a substrate;
a bottom electrode on the substrate, the bottom electrode having a planar
portion and a vertical portion;
30 a middle interlayer insulating layer on the substrate and the bottom electrode,
the middle interlayer insulating layer defining a contact hole that exposes at least a
part of the vertical portion of the bottom electrode;
a phase changeable material layer pattern in the contact hole, the phase
changeable material layer pattern having a sidewall portion that extends out of the

contact hole and across a portion of the middle interlayer insulating layer; and
a top electrode on the phase changeable material layer pattern, the top
electrode having a tip that extends toward the vertical portion of the bottom electrode.

5 7. The phase changeable memory cell of claim 6, further comprising a
spacer pattern between a sidewall of the contact hole and the phase changeable
material layer pattern in the contact hole.

10 8. The phase changeable memory cell of claim 6, wherein the bottom
electrode is cylindrical, and the vertical portion of the bottom electrode extends from
an edge of the planar portion of the bottom electrode, and further comprising a mold
layer on the planar portion of the bottom electrode and adjacent to the vertical portion
of the bottom electrode, and wherein the middle interlayer insulating layer covers the
mold layer, and the contact hole exposes the mold layer adjacent to the exposed
15 vertical portion of the bottom electrode.

 9. The phase changeable memory cell of claim 6, further comprising:
a lower interlayer insulating layer between the bottom electrode and the
substrate; and
20 a contact plug extending through the lower interlayer insulating layer to
electrically connect the bottom electrode with the substrate.

 10. The phase changeable memory cell of claim 6, further comprising an
etch stop layer between the bottom electrode and the middle interlayer insulating
25 layer.

 11. The phase changeable memory cell of claim 6, further comprising a
shield layer that covers a sidewall of the phase changeable material layer pattern.

30 12. The phase changeable memory cell of claim 6, further comprising a
plate electrode on the top electrode, wherein the plate electrode is electrically
connected to the top electrode.

 13. A phase changeable memory cell, comprising:

a substrate;

a bottom electrode on the substrate, the bottom electrode having a planar portion and a vertical portion;

a middle interlayer insulating layer on the substrate and the bottom electrode,
5 the middle interlayer insulating layer defining a contact hole that exposes at least a part of the vertical portion of the bottom electrode;

a phase changeable material layer pattern in the contact hole; and

a top electrode on the phase changeable material layer pattern, the top electrode having a tip that extends toward the vertical portion of the bottom electrode.

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14. The phase changeable memory cell of claim 13, further comprising a spacer pattern between a sidewall of the contact hole and the phase changeable material layer pattern in the contact hole.

15 15. The phase changeable memory cell of claim 13, wherein the phase changeable material layer pattern is directly on the vertical portion of the bottom electrode.

20 16. The phase changeable memory cell of claim 13, wherein the vertical portion of the bottom electrode extends from an edge of the planar portion of the bottom electrode, and further comprising a mold layer on the planar portion of the bottom electrode and adjacent to the vertical portion of the bottom electrode, and wherein the middle interlayer insulating layer covers the mold layer and the contact hole exposes the mold layer adjacent to the exposed vertical portion of the bottom
25 electrode.

17. The phase changeable memory cell of claim 13, further comprising:
a lower interlayer insulating layer between the bottom electrode and the substrate; and
30 a contact plug extending through the lower interlayer insulating layer to electrically connect the bottom electrode with the substrate.

18. The phase changeable memory cell of claim 13, further comprising an etch stop layer between the bottom electrode and the middle interlayer insulating

layer.

19. The phase changeable memory cell of claim 13 further comprising a plate electrode on the top electrode, wherein the plate electrode is electrically
5 connected to the top electrode.

20. A method of fabricating a phase changeable memory cell, the method comprising:

providing a substrate;
10 forming a bottom electrode on the substrate;
forming a phase changeable material layer on the bottom electrode; and
forming a top electrode on the phase changeable material layer, the top electrode having a tip that extends toward the bottom electrode.

15 21. The method of claim 20, further comprising:

forming a middle interlayer insulating layer on the bottom electrode, wherein the middle interlayer insulating layer defines a contact hole that exposes a part of the bottom electrode, and wherein forming a phase changeable material layer on the bottom electrode comprises forming the phase change material layer in the contact
20 hole, the phase changeable material layer having a dented portion protruding toward the bottom electrode, and wherein forming a top electrode on the phase changeable material layer comprises forming a conductive layer on the phase changeable material layer including in the dented portion of the phase changeable material layer.

25 22. The method of claim 20, wherein forming a bottom electrode comprises forming the bottom electrode with a planar portion and a vertical portion, and wherein forming a top electrode comprises forming the top electrode so that the tip extends toward the vertical portion of the bottom electrode.

30 23. The method of claim 20, further comprising:

forming a middle interlayer insulating layer on the bottom electrode, wherein the middle interlayer insulating layer defines a contact hole that exposes a part of the vertical portion of the bottom electrode, and wherein forming a phase changeable material layer on the bottom electrode comprises forming the phase change material

layer in the contact hole and having a dented portion that extends toward the vertical portion of the bottom electrode, and wherein forming a top electrode on the phase changeable material layer comprises forming a conductive layer on the phase changeable material layer including in the dented portion of the phase changeable material layer.

24. A method of fabricating a phase changeable memory cell, the method comprising:

providing a substrate;

10 forming a first mold layer that defines a hole that exposes a portion of the substrate;

forming a conductive layer on the substrate and the first mold layer;

forming a second mold layer on the conductive layer;

planarizing the second mold layer and the conductive layer to form a

15 cylindrical bottom electrode covering a bottom of the hole in the first mold layer and having a vertical portion along a sidewall of the hole in the first mold layer;

forming a middle interlayer insulating layer on the substrate and the bottom electrode, the middle interlayer insulating layer defining a contact hole that exposes a part of the vertical portion of the cylindrical bottom electrode;

20 forming a spacer pattern covering a sidewall of the contact hole, the spacer pattern defining a hollow region on the exposed vertical portion of the cylindrical bottom electrode;

forming a phase changeable material layer on the spacer pattern in the hollow region, the phase changeable material layer having a dented portion;

25 forming a conductive layer on the phase changeable material layer; and

patterning the conductive layer and the phase changeable material layer to form a phase changeable material layer pattern and a top electrode that are stacked on the bottom electrode.

30 25. The method of claim 24 further comprises forming an etch stop layer on the substrate including the bottom electrode prior to forming the middle interlayer insulating layer.

26. The method of claim 25, wherein forming a middle interlayer

insulating layer comprises:

patterning the middle interlayer insulating layer to expose a portion of the etch stop layer; and

5 etching the exposed etch stop layer to expose a part of the vertical portion of the bottom electrode.

27. The method of claim 24, wherein the phase changeable material layer has a thickness that is greater than half of a width of a bottom portion of the hollow region in the spacer pattern.

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28. The method of claim 24, wherein forming a conductive layer on the phase changeable material layer comprises forming the conductive layer to define a tip that fills the dented portion of the phase changeable material layer and that extends toward the vertical portion of the bottom electrode.

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29. The method of claim 24, further comprising:

forming an upper interlayer insulating layer on the phase changeable material layer and the top electrode;

20 patterning the upper interlayer insulating layer to expose a portion of the top electrode; and

forming a plate electrode on the upper interlayer insulating layer and directly on the exposed portion of the top electrode.

30. The method of claim 29, further comprises forming a shield layer on the phase changeable material layer pattern and the top electrode prior to forming the upper interlayer insulating layer, the shield layer covering at least a sidewall portion of the phase changeable material layer.

31. A method of fabricating a phase changeable memory cell, the method comprising:

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providing a substrate;

forming a first mold layer having a hole exposing a portion of the substrate;

forming a conductive layer on the substrate and the first mold layer;

forming a second mold layer on the conductive layer;

planarizing the second mold layer and the conductive layer to form a cylindrical bottom electrode that covers a bottom of the hole in the first mold layer and having a vertical portion along a sidewall of the hole in the first mold layer;

forming a middle interlayer insulating layer on the substrate and the bottom electrode, the middle interlayer insulating layer defining a contact hole that exposes a part of the vertical portion of the cylindrical bottom electrode;

forming a spacer pattern covering a sidewall of the contact hole, the spacer pattern defining a hollow region on the exposed vertical portion of the cylindrical bottom electrode;

forming a phase changeable material layer pattern in the hollow region and on the exposed vertical portion, the phase changeable material layer pattern having a dented portion in the hollow region;

forming a conductive layer on the phase changeable material layer pattern; and patterning the conductive layer to form a top electrode on the phase changeable material layer pattern.

32. The method of claim 31, further comprising forming an etch stop layer on the bottom electrode prior to forming a middle interlayer insulating layer.

33. The method of claim 32, wherein forming a middle interlayer insulating layer comprises:

patterning the middle interlayer insulating layer to expose a portion of the etch stop layer; and

etching the exposed etch stop layer to expose a part of the vertical portion of the bottom electrode.

34. The method of claim 31, wherein forming a phase changeable material layer pattern comprises:

forming a phase changeable material layer in the hollow region, the phase changeable material layer having a dented portion that extends below a top surface of the middle interlayer insulating layer; and

planarizing the phase changeable material layer until the top surface of the middle interlayer insulating layer is exposed.

35. The method of claim 31, wherein forming a conductive layer on the phase changeable material layer pattern comprises forming the conductive layer to define a tip that fills the dented portion of the phase changeable material layer and extends toward the vertical portion of the bottom electrode.

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36. The method of claim 31, further comprising:

forming an upper interlayer insulating layer on the top electrode;

patterning the upper interlayer insulating layer to expose a portion of the top electrode; and

10 forming a plate electrode on the upper interlayer insulating layer and directly on the exposed top electrode.